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SCIENTIFIC PERSONNEL WORK IN THE ARMY[1]

THE sciences dealing with human nature were brought to bear upon the problems forced upon America by the world war. Anthropology and psychology, economics and statistics, history, sociology and education, were put in service to improve our use of manpower, just as the physical and biological sciences were put in service to increase, economize and mobilize the nation's physical resources.

Consider a few illustrations. At one of the cantonments, within a few months' time, over 30,000 men were given a uniform standard intelligence-test and, as a dircet result of it, 600 men who would have been a detriment and even a positive danger to their fellow soldiers were sent away before time and money were wasted on their military education.

Certain very important institutions were receiving candidates a large percentage of whom were discarded, with little but discouragement and envy to show in return for the expense of their time and the government's money. Yet these candidates were chosen by a system which already represented the acme of common sense administered by extremely able men. A scientific study of some five hundred cases showed where much of the trouble lay and provided a remedy.

Under the pressure of the war the regular army scheme for measuring the qualifications and efficiency of its officers could not be operated. Nor would it have been suitable for the two hundred thousand officers taken from civil life with only a few months of military training. A workable record and rating plan was prepared by an expert in applied psychol-

[1] Address of the vice-president and chairman of Section H, Anthropology and Psychology, Baltimore, December, 1918.

ogy, tested carefully in certain camps, and put into force throughout the army.

At one of the largest naval radio schools the candidates were admitted in part through a series of tests devised for the purpose by one man of science, and their instruction was directed by methods devised by another.

In one of the large munition factories, a number of psychologists were kept constantly at work studying the means of selecting the right individuals as employees and finding the optimum conditions for their work.

Multiply such cases as these many many times; add to them the scientific personnel work done by physiologists and medical men; add further that done by the many modern business men whose work is so based on principles and verified by experiment that we should gladly claim them as fellow scientists —and the total would probably be the greatest increase in scientific control over the management of men ever made in any year in any country.

Until the war-history of the scientific activities of the National Research Council, the various emergency boards and bureaus, and the military organizations themselves is written, nobody will be able to describe or assess this work as a whole or the particular share of it due to applied psychology. I regret also that circumstances have prevented me from speaking, as I had hoped to do, from even a partial study of the records and reports available in manuscript in Washington and elsewhere. I can speak only in a very informal way in reminiscence of the activities seen, or shared, during these eighteen months.

Scientific personnel work has followed two main lines which we may call *mass* work and *analytic* work. These of course shade into each other and almost always cooperate, but the distinction will be helpful, at least for presentation.

MASS WORK

As a result of the prompt, energetic and patient labors of Yerkes and his associates of the psychology committee of the National Research Council, and of the subcommittee of the American Psychological Association, about seventeen hundred thousand soldiers were given a standard examination for intelligence, so devised that a small organization of examiners and clerical helpers could test and report on five hundred or more individuals a day. Within a day or two after a train-load of recruits reached a camp, it was possible for the camp psychologist to give substantial aid in such matters as:

1. The discovery of men whose superior intelligence suggests their consideration for advancement, for example, to posts as non-commissioned officers.

2. The discovery of men whose low grade of intelligence renders them either a burden or a menace to the service.

3. The selection and assignment to Development Battalions of men who are so inferior mentally, that they are suited only for special work.

4. The prevention of undesirable differences of mental strength between different regiments or companies.

5. The early recognition of the mentally slow as contrasted with the stubborn or disobedient.[2]

The history of this work in its early stages has been related by Yerkes, and its later development will doubtless be made public. Amongst the many important contributions to knowledge of the significance of such a test, I quote one from the preliminary report recently issued.

The median scores for recruits from different civil occupations are in summarized form as follows:

45 to 49	50 to 54
Farmer	Stationary gas-engine man
Laborer	Horse hostler
General miner	Horse shoer
Teamster	Tailor
	General boiler maker
	Barber

55 to 59	60 to 64
General carpenter	General machinist
Painter	Lathe hand
Heavy truck chauffeur	General blacksmith
Horse trainer	Brakeman
Baker	Locomotive fireman
Cook	Auto chauffeur
Concrete or cement worker	Telegraph and telephone lineman
Mine drill runner	Butcher

[2] From "Army Mental Tests."

Bricklayer
Cobbler
Caterer

65 to 69
Laundryman
Plumber
Auto repairman
General pipe-fitter
Auto engine mechanic
Auto assembler
General mechanic
Tool and gauge maker
Stock checker
Detective and policeman
Tool-room expert
Ship carpenter
Gunsmith
Marine engine man
Hand riveter
Telephone operator

85 to 89
Photographer

95 to 99
General clerk
Filing clerk

105 to 109
Mechanical engineer

115 to 119
Stenographer
Typist
Accountant
Civil engineer

125 and over
Army chaplains
Engineer officers

Bridge carpenter
Railroad conductor
Railroad shop mechanic
Locomotive engineer

70 to 74
Truckmaster
Farrier and veterinarian

75 to 79
Receiving clerk
Shipping clerk
Stock keeper

80 to 84
General electrician
Telegrapher
Band musician
Concrete construction foreman

90 to 94
Railroad clerk

100 to 104
Bookkeeper

110 to 119
Mechanical draughtsman

120 to 125
Y. M. C. A. secretaries
Medical officers

This table shows conclusively that in the sort of ability measured by the test (1) skilled mechanics and tradesmen, men who work with tools, are in general very closely alike and very low—near the level of the unskilled laborer; (2) clerical workers are in general very high—near the level of professional men. Either the clerical worker is a man of much greater general intelligence than the blacksmith, carpenter, locomotive engineer, machinist, tool maker, gunsmith or assembler; or the ability measured by the test is very much specialized; or both of these statements are true in a more moderate form. The matter is one of great importance. In proportion as it is true that the more intelligent men seek clerical work rather than work in skilled trades, an essentially invidious class distinction will tend to have a real basis in fact; and the management of business concerns will tend to fall into the hands of men trained in the office and salesroom rather than in the shop. In proportion as this representative of our standard tests of intelligence is specialized, overweighting ability to think with words and symbols in comparison with ability to think with materials and mechanisms, our whole procedure in measuring intelligence requires a critical review; and probably the common view of intelligence requires reconstruction.

No less significant is the variability within each occupational group. Taking the measurements as they stand, the 75 percentile unskilled laborer is up to the level of the median general mechanic, tool-room expert, or automobile mechanic, and up to the level of the 25 percentile mechanical engineer. The 75 percentile railroad clerk is at the level of the average accountant or civil engineer. The 75 percentile receiving or shipping cleark is at the level of the 25 percentile physician. This variability would be reduced by longer and repeated tests, but, unless the test as given has a very large probable error, it would still be enormous. It would still imply that there were in the occupations supposed to demand a high minimum standard of intelligence, a very large number of dull men; and in the occupations supposed to give little opportunity for the use of intellect, a very large number of gifted men and consequently a large unused surplus of intellect. Further information concerning the exact nature of the abilities of which the test is symptomatic is evidently important here.

As one considers the use of intelligence tests in the army, the question at once arises, "If for the sake of war we can measure roughly the intelligence of a third of a million soldiers a month, and find it profitable to do so, can we not each year measure the intelligence of every child coming ten years of age, and will not that be still more profitable?" A more extended test such as will place an individual on the scale for intellect for his age with an average error of not over 0.2 the mean square deviation for his age, would

doubtless be desirable. A more varied test which will prophesy ability to work with things and human beings as well as ideas and symbols would doubtless be desirable. Series of tests that could be made public without serious injury from deliberate preparation by tutors would also be desirable, and probably necessary. However, even with these more rigorous requirements, the expense for an annual nation-wide inventory of the intelligence of the ten-year-old cross section would not equal the cost of the war to America alone for five hours.

The results of such a census of intellect, especially if repeated at 14, 18, 22, would give superintendents of schools, commissioners of charity, mayors of cities and governors of states facts which they really need every day in their business.

A second main line of scientific work for large groups of soldiers was carried on by the Committee on Classification of Personnel in the Army under the leadership of Walter Dill Scott.

As a result of work done by him for the army in the first months of the war there was constituted in August of 1917 a Civilian Committee[3] of seven psychologists and three experts in the selection of men for employment. This committee worked first under the jurisdiction of the Adjutant General and later under the General Staff. This committee urged, and was soon entrusted with, the work of planning and carrying out an inventory of the man power of the National Army and establishing Personnel units in each of the sixteen cantonments. By these means each man's special abilities could be considered so that the right man would be put in the right place. These personnel units were found to be of direct practical service, were soon established in the National Guard as well as in the National Army, and were later extended to the Staff Corps and to the Students' Army Training Corps. Schools were established to train officers in the committee's system of interviewing recruits, recording their abilities and training, and using these facts in placing and transferring men.

A modern army is specialized into over two hundred occupations each as essential in its way to success in war as is the combat work of infantrymen, machine gunners or signallers. An army fights with a force of specialists ranging from artists to automatic-screw operator, bacteriologist to butcher, cargador to cupola tender, detective to dog trainer. The Committee on Classification of Personnel had to fill such orders for man power as:

One hundred and five artists, scene painters, architects, etc., for camouflage work for the Engineer Corps.

Three thousand typists, needed at once.

Forty-five enlisted men capable of leadership who are competent in the distribution and handling of oils and gasolines, fit to receive commissions in the Quartermaster Corps.

Professors of mathematics equipped to teach in the Field Artillery schools.

Meteorologists and physicists able to learn quickly to make meteorological observations and predictions.

Six hundred chauffeurs who speak French.

Electric crane operators.

In August, 1918, nearly four hundred such requisitions calling for over two hundred thousand men were filled. They had to be filled promptly in almost every case, and each had to be filled so as to leave the best possible material to fill every other requisition.

From one point of view this work was simply that of an enormous and glorified employment agency; and the scientists and business men engaged in it would be content if they had done nothing more than conduct an efficient agency for supplying to the army the skill it needed, when and where it needed it. From another point of view the work was a continuous study of human nature and application of scientific management.

In connection with the inventory of each man's abilities, tests to measure proficiency in each of about a hundred trades were devised, in the eight months from March, 1918. By the end of October these tests were in regular

[3] Just before the close of the war, the members of the committee and the group of associates whom they had organized were being commissioned.

operation in twenty-one cantonments, and about 125,000 men had been tested. Their operation made it sure that a man said to be a journeyman ship-carpenter really could do the work of a journeyman ship-carpenter if he was to be sent to the Emergency Fleet Corporation as such; that a man said to be a skilled truck-driver really could drive a truck as required in war-work, if he was to be sent to France for that work; that in general each man's statements and reported career were checked by objective test and measurement.

These trade tests were devised to fit the needs of the army in the war emergency and did so. They would need modification and extension to meet the needs of employers, labor unions, civil-service examining boards and the like. But the principles and methods according to which they were made have been fully justified. To the question "How well does individual A know trade I?" we can obtain a definite quantitative answer and can reduce its probable error to harmless dimensions. Just as we framed standard, workable, convenient, inexpensive, objective instruments to make sure that men assigned to certain work in the army could do that work satisfactorily, so we could upon order frame instruments which labor unions or civil service boards could use as admission examinations, which economists or business men could use in investigations of wages and production, or which a local survey could use in an intimate study of the total life of a community.

With respect to this inventory of manpower and organized effort to put the right man in the right place, it is probably no exaggeration to say that every thoughtful person who became well acquainted with its operation wished that it might be to some extent continued in peace time. "Why," we have been asked, "could not a progressive state inventory all its man power and plan for using it wisely for the purposes of peace?"

The special difficulties caused by geographical distribution and migration could probably be overcome, at least in certain of our states. The cooperation necessary from all citizens might be obtained. A system adequate for recording in usable form the essential facts for a state's entire population might be less expensive and quicker in action than would have been expected to be the case before the army methods were worked out.

An even greater difficulty lies in the fact that we lack laws, customs and experience concerning the use of such information; and it is hard to see just how efficient use of it to answer reasonable queries by federal and state bureaus, chambers of commerce, labor unions, boards of education and other reputable organizations could be encouraged and improper uses by futile or even disreputable concerns could be avoided. If a state could be sure that the information would be used by the right persons in the right way, it might therefore reasonably consider trying to make and maintain such an individualized inventory of its man power.

ANALYTIC WORK

What is called, for lack of a better term, analytical personnel work, is more or less clearly distinguished from the mass work so far described in several ways. It affects fewer individuals; it affects them in more specialized ways; it depends more upon insight and experiment to learn what to do and less upon executive energy and organization for doing it. To such work many men have contributed, and I can only illustrate it.

Early in the war, the problem of selecting from a given number of men those best fitted for rapid training as gun pointers on shipboard was referred to the Subcommittee on the Psychology of Special Abilities, and at their request referred to Dr. Raymond Dodge. He studied the task of the gun-trainer and pointer, the situations and responses involved, the methods of testing their ability then in use, the men from whom selections would be made, and the practical conditions which any system of selection for this work must meet. He had the problem of imitating the apparent movements of the target which are caused by the rolling and pitching of the gun-platform as a distant object would appear to a gun-pointer on a destroyer, a battleship or an armed mer-

chantman. He solved this by moving the imitation target through an 84-phase series of combined sine curves at variable speeds by a simple set of eccentrics, motor-run. He had the problem of imitating the essentials of the control of the gun by the gun-pointer and of recording in a fuller and more convenient form the exact nature of the gunner's reactions in picking up the target, in getting on the bulls-eye, in keeping on, in firing when he was on, and in following through. He solved these by a simple graphic record showing all these reactions on a single line that could be accurately measured, or roughly estimated.

Subsequently he made an apparatus that could be used not only to test a prospective gun-pointer's ability, but also to train both gun-trainers and firing gun-pointers four at a time. The demand for these instruments has been so great that sixty have been built by the Navy for use at shore training stations. The success of this led to further similar work, especially on the problem of the listener, the lookout and the fire control party.

The selection of military aviators is interesting as showing the complexity of a single concrete personnel problem. To be a successful military aviator in the United States Army under the conditions of the great war required first, that the individual be able to complete a theoretical and practical course on the ground (in a School of Military Aeronautics); second, that he be able to learn to fly satisfactorily within a reasonable time in an Aviation School or "Flying School"; third, that he possess the mental and moral make-up qualifying him for a commission in the army; fourth, that he prove competent in actual military work "over the lines" as pursuit pilot, bombing pilot, or pilot carrying an observer, or as a pilot instructor.

If we had perfectly accurate measures of a hundred thousand men available for the four traits: (1) ability in the ground school; (2) ability in the primary training in the fundamentals of flying; (3) standing in the composite of manhood and devotion characteristic of the ideal commissioned officer; (4) fitness for the actual work of a military aviator at the front; we should still have a complex problem. For these four abilities are very imperfectly correlated. The correlation of (1) and (2) is apparently not over .3. The correlation of (1) and (3) is probably not over .5. That of (1) and (4) is almost certainly not over .4. That of (2) and (3) may be as low as .3. That of (2) and (4) and that of (3) and (4) are not known, but it is certain that neither is very near 1.00.

Consequently, even if perfect prophecies could be made in respect to a man's fitness for each of the four requirements, the use of them to give the maximum of satisfaction of (3) and (4) (general officer quality and actual success as a military aviator) with the minimum of waste of time and money in respect to (1) and (2) is a problem demanding careful analysis.

A far greater difficulty of course was to discover means of prophesying abilities in a school such as had never before existed, in an art which only a few score men in the country had learned, and in a form of warfare which was only three years old and was changing its nature radically every few months.

Progress was necessarily slow and piecemeal, and anything like a complete and precise bill of specifications of the successful military aviator in terms of traits observable in a young man at work and at play on the ground is still remote.

Some of the steps in the progress may serve to illustrate further the analytic side of personnel work. In a study of the qualities used by examining boards to select future aviators, it was apparent that amount of schooling was the closest symptom of success in the work of the ground school. An experimental investigation was then undertaken to decide whether the score in a systematic test of intelligence or mental alertness might not be a useful addition to the scores for amount of schooling. Such a test was devised which gave a better prophecy of success in the ground school than amount of schooling, the correlations being, respectively, about *.50* and *.25*. Application of the partial correlation technique showed that the test score was the primary factor, amount

of schooling having its significance in this case chiefly indirectly as evidence of the possession of the abilities measured by the test. The correlation of the test score, independent of schooling, with success in the ground school was about .4. The correlation of amount of schooling, independent of the test, with success in the ground school, was less than .2. Amount of schooling is thus shown to be useful rather as a rough symptom of breeding, social status and viewpoint than as an index of intellect. That is better measured by a systematic test.

It could be affirmed a priori that the score in the test of mental alertness would not select against success in ability at flying itself, general fitness to be an officer, or success in actual warfare over the lines. But it might be that, if very accurately prophetic symptoms of these were at hand, they should be used pure, undiluted by mental alertness.

Consequently the significance of the test score for these was determined and compared with other symptoms. To make a short story out of a long and laborious inquiry, it was found that the test score correlated positively (about .3) with ability to learn to fly, and also with general officer-quality. Had the war lasted its correlation with success at the front would have been determined. It was also shown that dilution of a more valuable symptom by the test score was in all probability impossible, since the test score retained a positive partial correlation, independent of such more valuable symptom. Thus, although what we may call athletic mechanical ability (as in sailing a boat, riding a horse or motor-cycle, or shooting) sems to correlate much more closely with ability to fly well, than does the test score, a properly weighted composite of the two correlates still more closely. The same will hold of a composite with courage, or with nervous stability. So the test score may be used as an aid in selection for fitness for one of the four requirements, without fear of selecting the less fit for any other one of the four.

Almost as soon as the training of reserve military aviators began, in June and July, 1917, Burtt, Troland and Miles at Cambridge, and Stratton at San Diego, began a tryout of tests such as their consideration of the reactions involved led them to think might be prophetic of success in learning to fly. Later the writer investigated the physical, personal, educational and athletic records of men reported as superior and inferior by the flying schools as far as such reports were obtainable. Cooperation of the Committee on Classification of Personnel in the Army with the Personnel and Training Sections of the Division of Military Aeronautics, secured the detail of Dr. Henmon and Dr. Stratton in April, 1918, to study this problem further with a hundred men who learned to fly easily, a hundred men who learned to fly slowly or poorly, or not at all, and a hundred men taken for a test prophecy. It had already become apparent that no one trait of body or mind was clearly and closely correlated with success in flying—that a large number of factors were involved, so that a series of tests each properly weighted, must be combined to give a prophecy close enough to be of practical value. This series was made available for forty-five of the "unknowns" and a prophecy submitted to the effect that five of these cadets would show as many discharges or transfers for inability to learn to fly as all the other forty. This prophecy was verified and provision was made by the army for continued research along these lines under Captain Stratton, and for four special examining units under the direction of Captain Henmon to apply the tests to candidates for cadetships on a flying status.

In the spring and summer of 1918 Eno, aided by Fry, had been working on an apparatus to mimic to some extent the reactions involved in pointing a plane quickly and accurately at a target and to record these reactions in a precise and usable form. Dunlap had developed a systematic test of the changes produced by oxygen-want in an individual's ability in a complex sensory-motor performance somewhat equal in difficulty to the work of a man in combat flying. This was adopted as a regular feature of the differential test of a flyer's ability to withstand oxygen-want in

high altitudes. Parsons was testing the significance of the duration of nystagmus after rotation for future success in flying in the case of naval aviators; and his negative results were corroborated by the writer, and supported by Dodge's analysis of the reaction themselves. Shepard had devised and was standardizing tests of observation of a modifiable landscape. Other work helped to differentiate the qualities of a successful flying officer from those of a successful officer in general.

The formal procedure which was to go into operation for the selection of some twelve hundred aviation cadets per month from the Students' Army Training Corps, beginning in November, 1918, was in fact based in large measure on work done by men of science and the Personnel and Training Sections of the Air Service. Working together they had replaced the practise of selecting for flyers on the basis of general officer quality, by a bill of specifications of the sort of man demonstrably fit to complete the course in the ground school, learn to fly in a reasonable time, and give promise of achievement as a flying officer at the front. At the same time means were provided to do this without diverting from any other staff corps or from the line, men who, though fit to be flyers, were still fitter for other service.

I ought, in justice to the analytic personnel work, to give a wider sampling of its results, but I can not resist the temptation to use the few minutes remaining for two general reflections concerning psychology in relation to personnel practise in general.

The applied psychology or human engineering which has been developing so rapidly in the last decade has learned, in the war, if not before, that nothing short of the best in either ideas or men can do its work. Applied psychology is much more than cleverness and common sense using the facts and principles found in the standard texts. It is scientific work, research on problems of human nature complicated by conditions of the shop or school or army, restricted by time and labor cost, and directed by imperative needs.

The secret of success in applied psychology or human engineering is to be rigorously scientific. On every occasion when the principles of sound procedure were relaxed because of some real or fancied necessity, the work suffered. The chief principles in much of this personnel work concerned obtaining data from the sources possessed of fullest and most intimate knowledge, working only with data of measured reliability, determining the significance of facts by their proved consequences and correlations, and verifying conclusions by a prophecy and experiment. Whenever we made the extra effort and sacrifice necessary to tap the best sources of information about a man, rather than the next to the best, there was a gain. When we took pains to compute the reliability coefficients of all our data before going further with them, we saved time in the long run. Every failure to check apparent meanings by objective correlations was disastrous. An unverified hypothesis may possibly be a relatively harmless luxury if all one does with it is to think; to act on it is a grave danger.

Making psychology for business or industry or the army is harder than making psychology for other psychologists, and intrinsically requires higher talents. The scientist doing work for the inspection of other men of science is in large measure free to choose his topics, and to follow up any one important outcome regardless of what task he originally set himself. The scientist who is assigned a problem and is without credit if, instead of its answer, he produces something eventually far more important, has to be more adaptable, more persistent and more ingenious, if he is to succeed equally often. It is relatively easy to be scientific when you can direct your talent in any one of ten thousand directions; yourself asking the questions for which you proceed to find answers! Psychology applied to the complicated problems of personnel work represents scientific research of the most subtle, involved, and laborious type.

I have by intention omitted the names of the psychologists who have shared in this work, save where identification seemed necessary.

The list would be far too long. At the close of the war over a hundred psychologists had received or were about to receive commissions in the army; many more were doing work equal in merit to that done by the men commissioned; many were fulfilling the regular duties of teaching and devoting to war work the time previously given to scholarship, research and personal affairs; many more were carrying the extra burdens of regular work due to the more direct national service of others. If there were any differences in sacrifice or in achievement, they may well be left hidden in the more important fact that the psychologists of America worked to help win the war and worked together.

E. L. THORNDIKE

PUMPELLY'S REMINISCENCES[1]

PHYSICISTS and farmers are agreed that after the cider has been squeezed out, what remains of two apples can be contained in less than the volume of one. So it is with these "Reminiscences": by squeezing out the rich juice of the narrative, as some impatient and matter-of-fact man of the street might advise, the remains of the two large volumes could be reduced to a single small one; but how disappointed that compressed record, with every story dried to mere pomace, would have left the lingering reader! The detailed narratives of deliberate pages like these are not only of deep interest to many sympathetic contemporaries of the author, but of immense value to their studious successors; for the well-filled books reveal the deeper meaning that lies behind a mere chronicle of events and dates. Would that more of our eminent men might employ the leisure of their later years—if perchance their later years are spent in leisure—in writing out their memories, for the enjoyment of their younger friends and the edification of posterity. Yet with respect to the Reminiscences before us, posterity should be warned not to take them as the record of an average geologist of our times; for while all notable men are of their own pattern, Pumpelly's life has been the very extreme of individuality. Furthermore, contemporary parents of boys who gather minerals and fossils should, in spite of the disregard of America's leading educator's advice shown by our protagonist in the training of Raphael junior, beware of letting their sons embark upon an erratic education of the kind here set forth, in the hope that they will repeat the extraordinary career to which it led; unless they miraculously possess a Pumpellian heart, head and body—a pure and guileless heart, a clear and sagacious head, and a strong and courageous body; and of that rare endowment our sons have not one chance in many thousands.

Aldrich's "Bad Boy" was a little chocolate saint along side of young Raphael in his native New York town of Owego about the middle of the last century, where his piratical adventures, after reaching the high level of a stabbing affray in a quarrel over the division of booty among the members of the gang, were cut short by a wise mother's appeal to family pride, clinched by a more corporeal argument. A few years later a daring climb up the cliff of West Rock at New Haven, where the lad was attending a preparatory school, ought alone to have qualified him for admission to the geological course at Yale, had he not soon afterwards, on reaching the responsible age of seventeen, suddenly decided to forego the advantages there offered and, improving vastly on his grandfather's trite device of entering upon a life of adventure by running away to sea, announced to a well-selected one of his two parents that he wished to study in Germany. She, after the manner of her tactful kind, presented the proposition to her husband, who, after the fashion that has prevailed with men in his difficult position since the days of Eden, assented; and in 1854 mother and son crossed the Atlantic in a sailing vessel to Hamburg.

Hanover was selected as a first station of educational progress, and there two professors were promptly chosen; one was a riding

[1] *My Reminiscences.* By RAPHAEL PUMPELLY. New York, Henry Holt and Co. 1918. With illustrations and maps. Two vols., 844 pages, numbered consecutively.

master, the other a fencing master. Under the latter the young man became so mighty with the "palash" that he wounded to the death a young English opponent; whereupon, instead of vainglorioously seeking more victims, he gave up fencing. His foreign professors included, besides the two "Ordentliche" above named, two "Ausserordentliche" in the persons of a landlady's daughters, who gave lessons in German, cards and dancing, with well conducted practical exercises. The youthful Raphael also met von Roemer and was shown his fossils; and he saw something of the Hanover Polytechnic students, of whom the most capacious exceeded four fold and more the untrained young America's modest maximum of twenty Schoppen at a sitting; but a single season of such carousing was his first and last; its excesses had no attraction for him. Indeed, in this and other lines his education seems to have been conducted on a strictly experimental basis and to have led to wise conclusions: proficiency was repeatedly reached in one art or another, but if the acquired art proved undesirable it was given up and another was tried. The young man therefore had all manner of adventures, pleasant and unpleasant; things were always happening to him. He tramped along the Rhine, collecting rocks and minerals; he rode over the Taunus hills with a fair American companion; he secretly pawned his mother's watch to a Jew at Marburg to get money for railway fares; and he tried his luck on the gambling tables at Wiesbaden. Then after a summer trip in Switzerland, of which little is told, mother and son went to Paris for the winter; manifestly his European education was becoming cosmopolitan.

The French capital proved attractive in various directions. Soon after arriving there, research led him to pick up a fine two-inch Brazilian topaz for a couple of francs from a dealer on the quais. The youth always had the luck with him. A little later he declined the cajoleries of a beauteous and tearful actress, and made instead a lasting friendship with an octagenarian baroness. Truly in friendship-making he had a magnificent and enviable capacity, and always chose from among the best: but the nonchalance of his daily doings was also magnificent, and is equalled only by the naïveté of the narrative in which the daily doings are recorded.

From Paris he went to Italy, still accompanied by the faithful mother, whose apron strings were slow to untie, whichever way he pulled them. At Naples, it came over him that he was not securing the education for which he had crossed the ocean—but on this point we venture to disagree. He climbed Vesuvius and gathered its minerals; he exhausted the family letter of credit, but soon prevailed upon a discriminating banker to advance needed funds; he went to Rome and had an interview with the Pope; and then to Florence. There waking one morning with a wish to wander forth in search of new educational experience, he took leave of his mother for a day or two and set out for Leghorn, with a letter of credit in his pocket for baggage. By the merest chance he went from Leghorn to Corsica, where he spent four months like a knight-errant in the Middle Ages; first enjoying an idyll—platonic—with a forester's young French wife, who sang to him of spring and youth; then roving over the wild mountains with shepherds and bandits galore; meanwhile keenly using his eyes and writing a few explanatory letters to his mother, which the trusty mountaineers failed to post.

Finally returning to Italy, as thoughtless as Theseus though with no Ariadne, he found his distressed parent, who instead of classically leaping from the Leghorn rocks, had as fruitlessly set the police looking for her lost boy all over Europe. She embraced but did not upbraid him, and the happy pair went to Vienna, where education was again taken under consideration; and from Vienna, on the advice of the osculatory old Noeggerath, the youth of nineteen went to Freiberg, with the beginnings of a beard that became famous in later life. On the way there at Dresden the apron strings were at last untied; the mother turned homeward alone and the son turned seriously to his studies—at least as seriously as any one studied in the Freiberg of that

time. But Corsica had charmed him; he revisited that romantic isle the following summer, and this time carried back the famous Mouflon, hero of great adventures, the telling of which in print to the invisible public can not, however, compare with the oral recital, not many years after the event, to a group of admiring boys around a camp fire in the woods of upper Michigan.

Let no one imagine that a glance over these selected items can replace the reading of the delightful autobiography which they introduce. What is here too briefly told is only a curtain raiser to the kaleidoscopic life led by this fascinating boy after he reached manhood. No abstract can do justice to his thrilling adventures as a mining engineer in Arizona—amazing revelations of the conditions that existed when there really was a western frontier; had Beadle, a famout littérateur of that time, known them, they would have made him despair over the poverty of his dime-novel inventions. Mining and smelting in Arizona were followed by geological explorations in Japan and China; it was in that epoch that our hero during a smallpox delirium, playfully fired his revolver, which had been, Arizona-fashion, left handy under the mattress, at his Chinese nurse, who thereupon selfishly resigned his post. The winter journey homeward across Siberia in a sleigh, during which, as a chapter-heading might put it, "A whiff of cigarette smoke passes the time o'day," is not likely to be repeated by the modern traveler, who finds even the Trans-Baikal express too slow. Then came a period of conventional life in New York where some commonplace years were passed; and this was followed by a humdrum engagement as professor of mining at Harvard; but very little did the professorial Pumpelly of those days resemble the customary philosopher plodding across the Common to a lecture, or the expectable mathematician trudging through the Delta after a faculty meeting. Indeed, it was credibly reported at the time that a street-urchin—a "mucker" in the slang of Harvard Square—on seeing this strange apparition in felt hat, long flowing beard, velveteen suit and riding boots, cantering along Kirkland Street, stopped in astonishment, exclaiming: "Golly, what a swell!"

Naturally enough the cantering gait, which so well suited the apparition, soon carried him out of Cambridge and into all parts of the country, as mining engineer, state geologist, director of the Northern Transcontinental Survey, and otherwise; until in 1903–04 he welcomed the approach of old age by conducting a rare journey of exploration, a Carnegie-Institution search for primitive man, into central Asia. Ten years later an excursion was made to Arizona: in the shadow of the loss of wife and mother, the father with son and daughters, who left their own children at home to make themselves boy and girls again, visited the frontier of 1860, where desperados then dwelt and where railroads, hotels and automobiles now flourish locally in the wide arid spaces. "Incidents" occurred of course, such as the near-loss of a toe, and a possible death from thirst in a dry stream bed; but these little affairs did not prevent a deep appreciation of the great empty wilderness with its glaring days of vast distances, and its calm nights below the starlit vault of the cloudless heavens. And from the desert the septuagenarian, once the boy pirate of Owego, the knight errant of Corsica, the student of Freiberg, the Arizona miner, the traveler in the Far East, the expert geological surveyor, the archeological explorer, all reaching their culmination in the genial grandfather, returned to his home in Newport to write his "Reminiscences." There his friends now find him in beautiful serenity. There the good wishes of many greatful readers attend him.

W. M. D.

PROFESSOR WILLIAMS AT YALE[1]

CORNELL and Yale are singularly linked in the life of Henry Shaler Williams. Professor Williams was born at Ithaca, graduated from Yale, then returned to Ithaca to teach at

[1] Address by Herbert E. Gregory, representing Yale University at the exercises in memory of Henry Shaler Williams, held at Sage Chapel, Cornell University, October 20, 1918.

Cornell. In 1892 he is again at Yale, returning in 1904 to Cornell, where his life work was finished. Six years of his young manhood were spent at Yale in undergraduate and graduate studies and eight years as professor of geology. Just twice that time was devoted to active service at Cornell. Yale thus shares with Cornell the prestige which comes from a great scientific name, and it is fitting that the two universities should join in commemoration of the life and services of Professor Williams.

The Yale records reveal little of Williams as an undergraduate except that his class work was well done, but it is easy to picture the boy taking walks along the shore of Long Island Sound collecting materials, bringing them home for study, and building the foundations for penetrating observation which later yielded such large returns to science. For Williams, the graduate student, the eager boy already devoted to the search for the hidden meaning of natural phenomena, the distinction between teacher and student broke down. Williams was a member of a small company of sympathetic, earnest men—faculty and students—who together carried on their investigations. The quality of his work as a graduate student is indicated by his thesis for the doctorate, which is not the elaboration of a task assigned by an instructor, but an exhaustive study and a significant contribution to science.

In 1892 Yale was confronted with a difficult problem. It became necessary to select a successor to James D. Dana, America's foremost geologist, and to fill the chair which for nearly a century had been made famous by Silliman and Dana. There were many able geologists in the country, but Professor Dana insisted on a man who combined preeminent attainments with personal character and faith, for the task in hand was not merely to present the facts and principles and methods of geology to successive groups of students, but to stand as an interpreter of the truths of nature. The doctrine of evolution in many quarters appeared to be in conflict with Christian faith. Great truths were to be reconciled and a great man was demanded for the task. Dana chose Professor Williams. And so it came about that after twenty years of distinguished service at Cornell, Williams came to Yale as Silliman professor of geology. He came at the time when the great "Manual of Geology" was taking final form, and took part in the statement of the theory and facts of evolution which brought the teaching of the "Manual" in harmony with the leading scientific thought of the day.

In the early nineties at Yale little room was found in the curriculum for geology. The subject was offered only to juniors and seniors and was so restricted that relatively few men could elect it. The records show that during the first two years of Professor Williams's professorship students elected geology for no particular reason, but soon the class was found to consist of men who were seriously interested in problems of nature and their bearings on life. Williams was not a "popular" teacher, as voted by the senior class. He knew no tricks of the lecture platform and cared little for applause. He found it difficult to formulate dramatic situations and impossible to be dogmatic; his statements were accompanied by qualifications and exceptions. Williams loved the truth as few men love it; he was not content with half truths. The effect of this style of teaching was easily seen in the reaction of the class. At first the teaching seemed confusing; few clear-cut sentences could be written in a note book and cramming for tests on the basis of catch phrases was a very difficult task. Before the end of the course, however, the class realized that under the name of geology they were learning the greatest lesson open to men—the method of weighing evidence and thus arriving at truth. Many students of Williams have duplicated my experience. I came in from classes in philosophy and classics and was surprised at the method and content of the course. I asked myself the question: Is this geology? I had thought that geology was the study of rocks and fossils and valuable minerals, but found it a method of clear thinking—a road to the fundamentals of intellectual and spiritual life.

As presented by Professor Williams geology was not a guide to making money or to the collection and labelling of natural objects. It was a method of adjusting one's thinking to great truths. The many students who came under Williams's influence learned to view the world in a new light. Space and time and matter and living organisms took on new meaning, and somehow assumed a spiritual aspect, so that knowledge was not mere acquisition of facts and methods, but a something which ennobled its possessor. Someway also the search for truths untarnished by mercenary or selfish motives tended to dissolve doubts and to land one on a solid foundation. Teaching which produces such results is a man's work.

Williams exerted a large influence through an advanced course in the philosophy of life and organisms—a course sometimes enrolling a dozen, sometimes one hundred or two hundred, as arrangement of the curriculum allowed choice on the part of students. The teachings of this course became campus discussion, and entered into the thinking of graduates, undergraduates and faculty. Its value was so obvious that after Williams returned to Cornell the course was again organized and is now one of the prominent features of the Yale curriculum.

At Yale we remember Professor Williams as a man wholly unselfish, who would not magnify his importance, who would not fight for what might be considered his rights. He was ready to use poorly equipped laboratories and class rooms and to take undesirable hours for teaching in order to advance the work of others. He freely shared his great fund of knowledge and experience and seemed more interested in the success of others than in his own success. Unselfishness and devotion to truth are the traits we remember in Williams. They characterized his personal relations, his teaching and his writing. More than any man of my acquaintance he exemplified the text: "Ye shall know the truth and the truth shall make ye free."

Williams's work lives in his writings and perhaps even more in his students, but his death is no small loss. Unselfish teachers of truth are rare in any generation.

HERBERT E. GREGORY

YALE UNIVERSITY

SCIENTIFIC EVENTS

AN INSTITUTE OF PHYSICAL AND CHEMICAL RESEARCH FOR JAPAN[1]

THE outbreak of the great war in 1914, which at once cut off the import, mainly from Germany, of dyestuffs, drugs and other products of daily necessity, and at one time almost gave rise to a panic in business, was responsible for producing a profound change in the mental attitude of the government officials, the business men, and, in fact, the whole nation towards science. Those who had in vain been preaching the supreme importance of cultivating science with all activity and pleading for public support now saw at once that the right opportunity presented itself, and lost no time in drawing up a definite plan for an institute of physical and chemical research—a plan which, though not ideal, was deemed to be practical and to meet the most urgent need. This, fortunately, obtained the cordial support of some of the most influential and public-spirited of the business men, particularly of Baron Shibusawa, and afterwards also of the government of which Count Okuma was at the time premier.

According to the plan, which was ultimately adopted, a fund of 5,000,000 yen (10 yen = £1) was to be raised by public subscription. Of this sum just about one half has already been promised, and is being paid in, almost wholly by those who have either commercial or industrial concerns in Tokyo and Yokohoma. The other half is, with good reason, expected to be contributed within a few years by those in Osaka, Kobe and other large and wealthy cities in the southwestern districts. The plan also included an application for a government subvention, and, in accordance with the bill passed by the Diet in its 1915–16 session, the government is giving the institute a subvention of 2,000,000 yen in ten years, whilst H.M.

[1] From *Nature*.

the Emperor has made a gift of 1,000,000 yen for promoting the object of the institute. The total fund, supposing that the public subscription comes up to the expected sum, would thus amount to 8,000,000 yen, of which about 2,500,000 yen has to be invested in land, buildings and equipment. But since the interest accruing from the fund is calculated to exceed the annual expenditure for the first six or seven, or even more, years, when the activity of the institute can not of necessity be very great, it is expected that at the end of ten years there will be left over a fund of about 6,000,000 yen, which, calculated at 5 per cent. interest, would yield an annual income of 300,000 yen. To this extent, herefore, the institute would be self-supporting, and it is roughly estimated on this basis that the number of staffs of all grades and of mechanics, laboratory boys, etc., would be between 100 and 120 in all. But it is evident that the institute must grow in both size and activity, and that, therefore, the above income would soon be found to be inadequate to meet the necessary expenses demanded by this growth. As the institute grows in activity, however, its importance will be more and more evident, and it is believed that there would then be no great difficulty in obtaining more money.

THE DEPLETED HERDS OF ENGLAND, FRANCE AND ITALY

Larger importations of meat and pork products from the United States, thus lessening the slaughtering of native animals, will be the most effective means of restoring the depleted animal herds of the United Kingdom, France and Italy. This is the information recently received from Dr. Vernon Kellogg, of the United States Food Administration, while in France on official business. Dr. Kellogg declares that the losses in cattle in France and Italy are especially serious, not only on account of the meat and milk ordinarily obtained from this source, but also on account of the loss of the services of cattle, through depletion, which are used as work animals on farms in both countries. He writes:

> The most recent statistics on animal herds, indicating the number now existing in allied countries, show a loss of cattle in France of 17 per cent.; in Italy of 14 per cent., with the United Kingdom showing no loss; sheep and goats, France, 41 per cent.; Italy, 1 per cent.; United Kingdom, 10 per cent.; pigs, France, 49 per cent.; Italy, 12.5 per cent.; United Kingdom, 25 per cent.; horses and mules, France, 37.5 per cent.; Italy, 25 per cent.; United Kingdom, not including animals not employed in agriculture, 4.5 per cent.
>
> The losses in cattle in France and Italy are not only serious on account of the meat involved, but are especially serious on account of milk and also of work, as cattle are used largely in both countries as work animals on the farms. It is highly important that the herds be restored as rapidly as possible, which can be done most effectively by larger importations of meat and pork products from America to lessen the slaughtering of native animals.
>
> The French and Belgian people now being released from formerly occupied territories are demanding and needing increased amounts of food over the former relief ration in order to restore health and strength so as to be able to work, thus making larger demands on imports from America.
>
> I have now been in France three weeks, eating in restaurants and hotels of all grades, and I have had butter on the table once and a total of six lumps of sugar. Saccharine is universally used in coffee and tea. The smaller sugar ration is mostly reserved for cooking.

THE USE OF NITRATE DURING THE WAR

Facts concerning the importation and use of nitrate during the war period, hitherto suppressed for military reasons, have been made public by C. H. MacDowell, director of the Chemicals Division of the War Industries Board.

In the fall of 1917 the Congress appropriated $10,000,000 to be used by the Agricultural Department in importing nitrate of soda to be sold by them to the farmers at cost. This was later made a revolving fund. Under this the War Industries Board procured for the Department of Agriculture some 109,000 long tons of nitrate for shipment from Chile during the winter and spring. Owing to disturbed shipping conditions in the early spring, it was impossible to bring in for February-March arrival the tonnage expected, and with the

needs developed by the expected spring offensive of the Germans, it became necssary to divert to France a large tonnage of nitrate for manufacture of explosives in that country and for further increasing production of explosives in this country for use in France. This immediate need made it impossible for the Department of Agriculture to secure boats sufficient to bring in the full 109,000 tons so that 66,778 tons was actually imported in time for use by the farmers for spring planting.

Owing to military necessity, publicity could not, of course, be given to the reason of the non-arrival of the nitrate sold to the farmers, and this inability to deliver was the cause of considerable felling on the part of users of nitrate of soda. The military necessity was the greatest one and the planters who were unable to get the nitrate were in this way contributing to the supply of explosives in France, which later led to the winning of the war.

The nitrate of soda situation in the United States up until about the first of August was a serious one, although every explosive and chemical plant was kept supplied with sufficient nitrate to maintain full operations at all times. This was done by drawing from government arsenal reserves and by transferring stocks from fertilizer manufacturers and other holders to plants when stocks were about exhausted. Owing to the shortage of nitrate, it was deemed wise to ask the importer to discontinue sales of nitrate to fertilizer manufacturers other than for the making of sulphuric acid, and after the first of July all consignments of nitrate arriving in the country sold to such manufacturers were commandeered by the Ordnance Department and turned over to munitions and chemical manufacturers. These contracts thus handled were made between the importers and the fertilizer people in the fall of 1917.

Immediately on the signing of the armistice, all restrictions were taken off of the importers as far as sales of nitrate to fertilizer manufacturers and agricultural users was concerned, so that there will be no difficulty in supplying the entire needs of the United States for agricultural use for spring planting.

Nitrate of soda is the foundation of smokeless powder and high explosives as well as for other needed chemicals, and the purchase and importation of nitrate are conducted by government through the War Industries Board in cooperation with the importers formerly handling this material, the importers buying in Chile as in times past. The government received their nitrate through the importers at cost and the profit charged by the importers to private users was controlled by the government so that uniform cost to all users was secured, this cost being based on the average monthly cost in Chile, plus the freight storage, exchange, and other elements of cost.

A committee known as the Nitrate Committee of the United States was established with offices in New York and a New York representative of the War Industries Board represented that board in the offices of this committee. Government needs for nitrate were increasing rapidly and the 1919 requirements would have been very large. During the entire period of the war all needed nitrate was secured and there was no let up in the manufacture of war materials depending upon this article.

SCIENTIFIC NOTES AND NEWS

PROFESSOR WALLACE CLEMENT SABINE, professor of physics at Harvard University and formerly dean of the Lawrence Scientific School, died on January 10, aged fifty-one years.

DR. SIMON FLEXNER, director of the Laboratories of the Rockefeller Institute for Medical Research, has been elected a corresponding member of the Société des Hôpitaux de Paris, and has had the title of Officier de Legion d'Honneur conferred upon him by the French government.

THE American Phytological Society at its tenth annual meeting, held in Baltimore, December 23–28, elected the following officers: *President,* C. L. Shear, U. S. Department of Agriculture; *Vice-president,* I. E. Melhus, Iowa State College, Ames, Iowa; *Secretary-Treasurer,* Geo. R. Lyman, U. S. Department

of Agriculture; *Councilor,* Donald Reddick, Cornell University. Dr. Lyman was also elected Business Manager of Phytopathology for the year.

The following were elected officers of the Association of American Geographers at the Baltimore meeting: *President,* Professor Charles R. Dryer; *First Vice-president,* Dr. Herbert E. Gregory; *Second Vice-president,* Dr. Isaiah Bowman; *Secretary,* Dr. Oliver L. Fassig; *Treasurer,* Mr. Francois E. Matthes; *Councilor for three years,* Professor Eliot Blackwelder.

Professor C. K. Leith sailed for France on January 1 to act as mineral adviser for the U. S. Peace Commission. The party included Chairman B. M. Baruch, of the War Industries Board; Chairman Vance McCormick, of the War Trade Board, and Walter Tower, of the Shipping Board. For the past year Professor Leith has been in charge of the joint mineral work of these boards, with special reference to regulation of imports and exports.

Brigadier General William S. Thayer, who has been serving in France, will, on his return to this country within a few days, resume his duties as professor of medicine of the the Johns Hopkins Medical School. Dr. Thayer will take the place of Dr. Theodore C. Janeway, who died several months ago while serving on the staff of the Surgeon-General.

Major John M. Berry, formerly epidemiologist in the New York State Department of Health, has recently been promoted to the rank of lieutenant colonel.

Dr. Karl T. Compton, assistant professor of physics in Princeton University, has returned after a ten months' work for the Research Information Service in the capacity of associate scientific attaché to the American Embassy in Paris.

Dr. Ralph E. Wilson has left his work as an aeronautical mechanical engineer, Bureau of Aircraft Production, to accept a position as astronomer, Department of Meridian Astronomy, Carnegie Institution of Washington, stationed at the Dudley Observatory.

Mr. Neil M. Judd, assistant curator of anthropology, U. S. National Museum, has returned to Washington after eleven months' service in the aviation section of the national army.

Dr. Oscar Harder has resigned his position in the research department of N. K. Fairbanks Co., Chicago, Ill., to accept a fellowship at the Mellon Institute of Industrial Research, Pittsburgh, Pa.

Assistant Professor Samuel D. Graydon, recently of the department of descriptive geometry and mechanical drawing, and who has been in continuous service at Stevens Institute of Technology as assistant professor since 1892, has been retired under the provisions of the Carnegie Foundation.

Dr. L. Baumann, assistant professor and director of research in the department of internal medicine of the University of Iowa, has resigned his position to take effect at the end of the present college year. He will live in New York City.

Mr. J. A. McClintock has resigned his position as extension specialist in cotton, truck and forage crop diseases, to which he had been appointed under a joint project between the U. S. Department of Agriculture and the Georgia State College of Agriculture.

At the request of the U. S. Food Administration, the Rockefeller Institute for Medical Research has granted a leave of absence to Dr. Israel S. Kleiner in order that he might take charge of Professor Lafayette B. Mendel's work at Yale University while the latter is attending the meetings of the Inter-Allied Food Commission abroad.

Professor Percy F. Frankland is retiring from the Mason chair of chemistry in the University of Birmingham at the end of the current term. In accepting the resignation with great regret, the council has expressed to Professor Franklin its thanks for valuable services rendered to the university during the past twenty-four years.

At the annual general meeting of the Faraday Society of London, held on November 12,

the following officers were elected: *President,* Sir Robert Hadfield, Bart., F.R.S.; *Vice-presidents,* W. R. Bousfield K.C., F.R.S., Professor F. G. Donnan, F.R.S., Dr. Eugene Haanel, Professor A. K. Huntington, Dr. T. Martin Lowry, F.R.S., Professor Alfred W. Porter, F.R.S.; *Treasurer,* Robert L. Mond; *Council,* G. S. Albright, W. R. Cooper, Dr. C. H. Desch, Dr. J. A. Harker, F.R.S., Emil Hatschek, Cosmo Johns, Harold Moore, E. H. Rayner, Dr. George Senter, Cav. Magg, E. Stassano.

AT the annual meeting of the Washington Academy of Sciences held at the Administration Building of the Carnegie Institution on January 14, 1919, the retiring president, Dr. Lyman J. Briggs, delivered an address on "The resistance of the air."

A JOINT meeting of the Washington Academy of Sciences and the Chemical Society of Washington was held on January 9, when Dr. F. B. Power, retiring president of the Chemical Society, delivered an illustrated address on "The distribution and character of some of the odorous principles of plants."

THE annual Darwin Lecture of New York University will be given on February 12 by Dr. C. L. Bristol, of the department of biology. In connection with the lecture a series of motion pictures of marine life made in Naples, Italy, will be shown by Dr. R. L. Ditmars, curator of reptiles, New York Zoological Gardens.

A CABLE message announces the death in Rome, on December 31, of David Lubin, of San Francisco, founder of the International Institute of Agriculture, and the American representative on its permanent board. He was born in 1841, and was formerly a merchant in Sacramento, where early in his career he made a fortune. He then devoted himself to economic reforms and was responsible for the establishment at Rome of an international agency for collecting official and reliable information from all parts of the world as to the acreage, output and ability of the cereal crops.

THROUGH an anonymous donor The Long Island College Hospital (Hoagland Laboratory) has had placed at its disposal a farm for keeping animals used in research. Already work and experimentation in fowl influenza (roup), diphtheria and chicken-pox have been begun.

UNIVERSITY AND EDUCATIONAL NEWS

PROPOSALS for extending the accommodation and equipment of the department of pathology and bacteriology at Leeds University have been approved. It is hoped to concentrate the whole of the bacteriological work of the city in the additional accommodation provided by adapting the premises adjacent to the medical school.

THE Massachusetts Institute of Technology plans to offer to students who have substantially completed courses leading to the degree of bachelor of science in chemistry or chemical engineering, an opportunity to enter the school of engineering practise in February. Two terms of preparatory work will be given at Cambridge, the first beginning February 17; it is expected that the work at the practise stations will begin about October 1, and continue until the following May. The general plan of the course will be the same as that carried out while the school was in operation just before the opening of the war.

THE REV. EDWARD P. TIVNAN, S.J., professor of chemistry and regent of the school of medicine, Fordham University, has been appointed president of the university, to succeed the Rev. Joseph A. Mulry, S.J.

THE departments of descriptive geometry and mechanical drawing and of mechanism and machine design at Stevens Institute of Technology have been combined to form a new department of machine design, of which Franklin DeR. Furman is professor and head. The work of the department has been organized with two divisions—one the mechanism division, in which William R. Halliday is assistant professor, and the other the mechanical drawing division, in which Edwin R. Knapp is professor and Samuel H. Lott, assistant professor. The following changes in rank have been made at the institute: Louis A. Hazeltine,

acting professor in the department of electrical engineering, to professor; Robert M. Anderson, acting professor in the department of engineering practise, to professor; Lewis E. Armstrong, instructor in the department of mathematics, to assistant professor.

Mr. Lester Yoder, formerly with the chemical section of the Agricultural Experiment Station of Iowa State College, is now at the U. S. Technological School, Carney's Point, N. J.

The chemistry department of the University of Nebraska announces the following additions to its teaching staff: Dr. Horace G. Deming, of the University of Illinois, as professor of chemistry in charge of general and physical chemistry; Mr. B. Clifford Hendricks, of Peru, Nebr., State Normal School, as assistant professor of chemistry; Mr. T. J. Thompson, of Kansas Wesleyan University, as instructor in organic chemistry.

DISCUSSION AND CORRESPONDENCE

THE LILLE SOCIETY OF SCIENCES

To the Editor of Science: I wish to call the attention of American scientists to the following extracts from a letter received from Dr. Charles Barrois, professor of geology at the University of Lille and actively interested in the Society of the Sciences of Lille. Dr. Barrois writes:

> For four years I have been cut off from the number of the living, reduced to servitude, without receiving a letter or a scientific book; I have not been able during this time to communicate with anybody in the world, nor to have any news of my family. That has been harder to me than physical sufferings and bombs.
>
> My geological institution has been twice demolished by bombs, but I was able to save the collections from the débris and they were respected by the Germans. Our library of the Society of Sciences was unfortunately burned so that I am much embarrassed in my work; the books of the Public Library were also burned, those of the university were saved, but that was the least important library.
>
> I am working at present to build up again my university, our Geological Society of the North, all the members of which are scattered, ruined or killed. I do not yet know if I shall succeed; books are necessary, and money is necessary to continue my publications and I fear it can not be obtained in France where they are much impoverished. I look sadly at the manuscripts of my confrères, entrusted to my care for publication. . . . I am quite a little disconcerted at being reduced to mendicancy in my old days, for our learned societies, but the American devotion and generosity have been shown so great in these latter days, that we believe we can be assisted by them openly.

If any one has any books or specimens that they think would be of assistance to Dr. Barrois and his associates in connection with the Library and Museum of the Society of the Sciences, the Smithsonian Institution will be very glad to transmit them to the society at Lille.

Charles D. Walcott

ROOT PRESSURE AND ROOT EXUDATION

A recent note in Science by Professor Kremers[1] upon the use of dahlias for experimental work upon osmosis reminds the writer of his use of the same plant for the demonstration of root pressure and the exudation of water in quantity. The growth from the tuberous roots is vigorous and in a short time is ready for the setting up of the experiment. The quantity of water exuded and the pressure are adequate for a thorough demonstration of these phenomena as outlined for example in Ganong's "Plant Physiology" and fully equal to the best plants which the writer has used in such demonstrations.

In this connection the writer wishes to express a thought which has been more and more impressed upon him in his work as a teacher of physiology, pathology and even morphology of plants. Each institution, and especially is this true of the smaller ones, is working out its technical problems in an isolated fashion, often repeating unprofitable experiments which have been found by other institutions to be unsuccessful. In other cases especially useful plants or types of ap-

[1] "Experimental Osmosis with a Living Membrane," Edward Kremers, Science, N. S., Vol. XLVIII., No. 1250, December 13, 1918, p. 599.

paratus are in use, the knowledge of which would be of great value both as time savers and as means of encouraging better teaching of botany. Why should there not be a free exchange of such methods and ideas through the medium of publication in one of our universally distributed journals such as SCIENCE? The writer suggests a special department, in such a magazine, devoted to technique where not only successful experiments in teaching are reported but also where negative results shall be stated. A magazine devoting space to such a department would do much toward advancing the technique of science. It may be objected that such notes do appear from time to time in various magazines. This is true, but the writer is convinced that only a very small number of such notes appear as compared with the total number of helpful suggestions which should be the common property of men working in the same science. In this branch of educational work at least there should be no selfish "patent" upon such matters to be used as a "drawing card" for the department or institution. Such a department devoted to notes upon technique would save all teachers of science much time which they now spend in fruitless testing out of methods which some other institution has already demonstrated to its own satisfaction to be unsatisfactory. There would also be a marked improvement in the teaching in the smaller institutions at least, by the introduction of newer and better technique.

ERNEST SHAW REYNOLDS
AGRICULTURAL COLLEGE, N. D.

GENERIC LIMITATIONS

THE deductions of Professor Robertson on this subject in SCIENCE for October 11 seem to be based upon questionable premises. Of the factors which influence the number of species in a genus, he mentions only the antiquity of the group. Other important factors are: specific limitations; size of group considered; area, location and diversity of territory included; degree of perfection of our knowledge of the species. These are illustrated in the following list:

	Species	Genera	Average	Poales
Cat. N. Am. Pl., Heller, 1900[1]	16,673	2,027	8.2	6.2
Gray's Manual, 7 ed., 1908.	4,079	1,001	4.1	6.7
Fl. S. E. U. S., Small, 1903.	6,364	1,494	4.4	6.7
R. Mt. Man., Coult. & Nels., 1909	2,733	649	4.2	4.2
R. Mt. Fl., Rydberg, 1918..	5,897	1,038	5.7	7.3
Fl. Colo., Rydberg, 1906 ...	2,912	702	4.2	4.7
Fl. N. Mex., Woot & Stand, 1915	2,903	848	3.4	4.1
Pl. of Conn., 1910	1,942	621	3.1	5.2
Fl. Mich., Beal, 1892	1,746	554	3.2	4.2
Fl. N. D., Bergman, 1918 ..	963	448	2.2	3.1
Fl. of Fargo, N. D., 1918...	520	295	1.8	2.3
Fl. Vigo Co., Ind., Blatchley, 1896	853	423	2.0	2.6
Bees of N. Mex., Ckll., 1906	561	72	7.8	—
Bees of Boulder Co., Colo., Ckll., 1907	175	42	4.1	—

It will be noted that the averages vary in proportion to size and diversity of territory. On account of this and narrow specific limits Rydberg's "Rocky Mountain Flora" is one of the highest, notwithstanding his narrow generic limits. New Mexico runs low on account of many Mexican genera entering the state.

Since the bees are but a suborder we may scarcely compare them with larger groups. The *Poales* are perhaps the most nearly comparative group of the plants, although relatively larger. The genus *Carex* is more nearly comparable than any other to the bee genus *Andrena,* the number of species being about equal.

From Robertson's list we find the bees of New Jersey are 2.7 per cent. of the total insect list, while those of Carlinville are 23.0 per cent.; similarly, the Lower Aculeata are 4.9 per cent. and 16.2 per cent. From this and our knowledge of the extent of his work on these groups we might conclude the averages for other groups to be low on account of their many unknown species.

Recognition of many small genera would seem to necessitate the elevation of old genera and larger groups to higher rank, thus greatly increasing group names. Classification serves two purposes. Names have been often called "handles," while the system presents the state of our knowledge of relationships. For the

[1] Includes varieties; others do not.

taxonomist, large numbers of names present little difficulty because he uses them frequently, but for others it is different. Thus probably not less than 90 per cent. of science workers are "beginners" and the others, outside of their special fields, are also. The writer believes in the recognition of small groups but doubts the necessity of forcing them upon every one. Would it not be feasible to have our floras and faunas in two parts, the first leading to collective groups, the second continuing through the smaller groups?

O. A. Stevens

Agricultural College,
North Dakota

FIREFLIES FLASHING IN UNISON

To the Editor of Science: I was much interested in Mr. Fremont Morris's letter regarding the "Fireflies Flashing in Unison" on page 418 of the last volume.

I was employed by the Philippine Bureau of Forestry during 1902 and 1903. In the spring of 1902, I was stationed for some weeks at Pagbilao, Tayabas Province. It is on a small tidewater river about half or three quarters of a mile from Lagimanoc Bay. I had occasion to go across this bay on February 22 and did not return until after dark. As the banca in which I was travelling entered the mouth of the river, I was attracted to the flashing of the flies which appeared in great numbers a short distance above the mangroves which covered both banks of the stream.

The majority of the fireflies were flashing in unison but there were some which did not time their flashes with the majority. The light from the fireflies with the reflection of the light from the water made a very distinct illumination and one never to be forgotten by one who has seen it.

P. T. Barnes
Pennsylvania Department of Agriculture

NEGATIVE RESULTS FROM ATTEMPTED QUEEN BEE MATING IN A DOUBLE TENT INCLOSURE

Following out suggestions from previous work of Cole and Miller, Rhode Island, and from bee behavior observations in an artificially lighted double tent at University of Wisconsin, by the writer, an attempt was made the past season to mate a Virgin queen bee in an available double tent inclosure.

The tent was made of double canvas, 4 feet in diameter, 7 feet high at peak, with about 8 inches space between the canvas walls.

A nucleus, containing workers, drones and a five-day-old virgin was placed in the tent and observations taken.

No natural mating flights occurred. The virgin appeared to fly naturally in the tent, returning unaided to the hive, when removed from the nucleus and thrown into the air. The drones appeared to fly naturally, more so at first than after several days confinement in the tent.

The queen failed to mate.

L. V. France
University of Minnesota,
University Farm, St. Paul

SPECIAL ARTICLES

SPECTRUM PHENOMENA DUE TO MOVING MOTES

In connection with my regular work I incidentally came upon a curious phenomenon which seemed to repay special investigation. To describe it, it will be advantageous to first indicate the disposition of apparatus used, as is done in Fig. 1. Here L is a pencil of white light (preferably from a collimator and wide slit) impinging on the thin cylindrical glass shell G, about 10 cm. in diameter and containing a solution of mercury-potassic iodide, about half an inch deep and not quite concentrated. The rays are thus both refracted and dispersed, and on emerging enter the strong objective of a short-range telescope (magnification above 15) of which PP' is the principal plane and $r'b'$ the narrow spectrum seen in the ocular of the telescope. Properly focusing the latter, the spectrum may be contracted to a vividly colored vertical line.

If now a strong direct-vision grating g is inserted in front of the objective, and the telescope is focused anew, a *sharp* solar spectrum may be obtained. This was a surprise to me, as the cylinder[1] G, though thin and clear, was

[1] The present use of a cylinder as a collimator is well worth noting.

obtained from samples of ordinary glass shades, such as are prized by the lovers of stuffed birds. In other words, the cylinder supplies its own slit within, as at *r* or *b* in the figure, by refraction. With a narrow beam of sunlight no collimator is needed.

The spectrum will now be found to be filled with short, slender, horizontal shadows moving endwise in a common direction, but at different speeds. On pushing the ocular in somewhat further, these shadows become sharply defined lines, all nearly horizontal, of all lengths from mere points to black lines half the length of the spectrum or more. On attentive observation the black lines are seen to

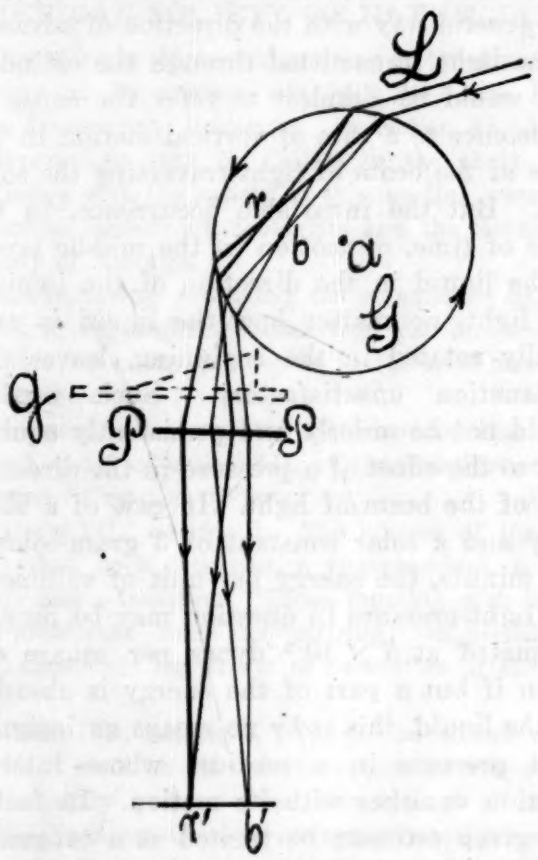

FIG. 1.

be associated with narrow areas of accentuated brightness, so that diffraction patterns are in question. Occasionally a beautiful complete slender spindle-shaped black body with a brilliant narrow frame of light around it, will appear. Arrowheads holding patches on their notched sides, are not infrequent; but as a whole the spectrum has the appearance of being intersected with an interminable array of slow horizontally flying arrows, shot in a common direction from end to end. With regard to the motion, this is more usually horizontally from red to blue; in the lapse of time and in the middle layers always so and not permanently from blue to red. Sometimes both motions were seen to occur together in different levels, the retrograde motion being relatively slow, less pervasive and confined to the top or the bottom layers of the liquid. All degrees of speed occurred from a passage through the spectrum in a fraction of a second, to passages lasting over a minute. Under the latter conditions it may happen that the particles actually stop and then begin a retrograde movement soon to be accelerated in turn. During this period of transition, particles may be seen also to rise and fall, but with relatively great slowness as compared with the usually horizontal motion. Some of the arrows are somewhat oblique to the horizontal. Under rare conditions I noticed a line of light instead of shadow. Breadths differ greatly and would naturally depend on focusing.

Usually the motion persists with apparently undiminished small velocity for hours, so that it much outlasts one's patience. Often a single particle can be observed for a minute or more; but after 10 or 20 hours all particles disappear and the spectrum is clear. From this I concluded that the diffractions are not due to local difference of density, etc., of the solution, as I first supposed, but actually originate in minute solid particles (or in case of other liquids in minute air bubbles) entrapped in the liquid. The slow subsidence and persistence of particles indicates this state of things.

Moreover I found that the initial motion of particles as a whole from red to blue or blue to red, could be controlled by *rotating* the cylinder *G* on its axis *a*, either counter-clockwise or the reverse, respectively. Brownian motions are excluded, since these are promiscuous and since the magnification is inadequate. It is difficult to conceive how the angular momenta impressed on this solution can persist for hours within it, after the solution is apparently quite at rest, even if the solution is of large

NOT TO BE

density (dense enough to float glass). Probably since the internal friction of liquids vanishes with the relative velocity of layers, and since the apparent motions are magnified, there are eventually no frictional torques left to absorb whatever angular momenta may be renewed. The occurrence of direct and retrograde motions at the same time, separated sharply by a plane of demarcation suggests vortices. Above this plane particles move with about the same speed in one direction, below the plane with a very different speed in the opposite direction. A particle which happens to be in the plane in question does not move at all. After a long interval the direction of the motions above and below a plane of demarcation may be found to have reversed, respectively. If a solution is cleared of particles by the lapse of a sufficient time for subsidence, they may be restored by brisk rotation. The number, size, density of color and speed of the particle naturally increase with the violence of rotation.

To conclude: After the cessation of the initial disturbances, the liquid, left to itself and owing to the presence of motes, shows a persistent motion of its middle layers in the general direction of the impinging beam of light, while the motion of the relatively thin layers at the top or bottom (one or both) is usually persistently retrograde, but slow in comparison. This continues, until after the lapse of hours the particles have practically subsided, when the retrograde motion seems to be equally prominent. Even when the liquid is manually rotated clockwise with violence, this impressed motion ceases in a few minutes whereupon the counterclockwise, red-blue motion, in the direction of the impinging beam, sets in vigorously.

It suffices to add a few statistical remarks. The telescope may be adapted for small distance by placing 3 diopter spectacle lenses in front of it. Its external focal plane is then only about a foot off and within the liquid. The rays seen in the ocular of the spectrotelescope may be regarded as coming from a virtual slit within the cylinder; or else, on narrowing the incident beam L to within a centimeter (in case of a cylinder 10 centimeter in diameter), the diffuse internal caustic has already been similarly narrowed down to a short internal spectrum rb in the figure. Hence if the solution rotates slowly about the axis a, particles enter the red (r), and leave the blue (b) end, and are therefore seen sharply in the spectrum travelling from red to violet. The reverse is the case if G rotates in the clockwise sense. The small distance rb is the virtually magnified by the immense dispersion of the grating (15,000 lines to inch) G. Since the rays cross *within* the cylinder, G, the motion from red to blue will also characterize all particles distinctly seen and rotating counterclockwise. Finally, this rotation corresponds in a general way with the direction of advance of the light transmitted through the cylinder.

It would be simplest to refer the cause of persistence to a case of vortical motion in the wake of the beam of light traversing the solution. But the invariable occurrence, in the lapse of time, of motion in the middle layers of the liquid in the direction of the impinging light, no matter how the liquid is artificially rotated in the beginning, leaves this explanation unsatisfactory. Such vortices would not be orderly and persistently equivalent to the effect of a pressure in the direction and of the beam of light. In case of a black body and a solar constant of 3 gram-colories per minute, the energy per unit of volume or the light pressure in question may be roughly estimated at 7×10^{-5} dynes per square cm. Even if but a part of the energy is absorbed by the liquid, this is by no means an insignificant pressure in a medium whose internal friction vanishes with its motion. In fact if the given estimate be treated as a tangential force relative to the surrounding dark liquid, of about .01 viscosity, a speed of 7×10^{-3} cm./sec. (under normal conditions) would correspond to the shear. One may therefore infer that speeds within a tenth millimeter per second, about of the order observed, are not impossible. The very slow but persistent regressive movement at the top and bottom of the layer of liquid remains unexplained. Furthermore I was unable to find any adequate corre-

spondence between the swiftness of the motion and the intensity of the impinging beam. Again, the molecular radiometer, in which the thermal gradient is at the same time a pressure gradient would fall under the same objections. I can only conclude vaguely, therefore that in some way the local vortices evoked by thermal distribution resolve themselves into a persistent ordered rotation[2] of the cylinder of liquid around its vertical axis, with the regressive motion specified confined to one or two relatively thin layers.

CARL BARUS

BROWN UNIVERSITY,
PROVIDENCE, R. I.

AMERICAN SOCIETY OF NATURALISTS

THE thirty-sixth annual meeting of the American Society of Naturalists was held at Johns Hopkins University, Baltimore, December 28, 1918, Vice-president Guy N. Collins in the chair. In affiliation with the society at this meeting were the American Society of Zoologists and the Botanical Society of America.

Illness having prevented the attendance of the treasurer the auditing committee was directed to examine his books and report at the next meeting of the society.

The executive committee recommended that sections 1 and 2 of article III. of the constitution be changed to read as follows:

Article III., Section 1. The officers of the society shall be a president, a vice-president, a secretary and a treasurer. These, together with three past-presidents and the retiring vice-president, shall constitute the executive committee of the society.

Article III., Section 2. The president and vice-president shall be elected for a term of one year, the secretary and treasurer for a term of three years. Each president on retirement shall serve on the executive committee for three years. Each vice-president on retirement shall serve on the executive committee for one year. The election of officers shall take place at the annual meeting of the society, and their official term shall commence at the close of the meeting at which they are elected.

This recommendation was referred back to the executive committee by the society with the suggestion that they consider further the form by which continuity of policy may best be attained.

There were elected to membership: William T. Bovie, Harvard Medical School; Walter B. Cannon, Harvard Medical School; Otto Glaser, University of Michigan; Donald F. Jones, Connecticut Agricultural Experiment Station; Lewis R. Jones, University of Wisconsin; Horatio H. Newman, University of Chicago; Victor E. Shelford, University of Illinois; Theobald Smith, Rockefeller Institute; Alonzo E. Taylor, University of Pennsylvania; Edgar N. Transeau, Ohio State University.

The following program was presented:

Parthenogenesis and sex determination in the white fly: A. F. SHULL and N. R. STOLL.

The evolution of nuclear conditions in Ciliata: M. M. METCALF.

The genetic interrelations of two dwarf perfect-flowered types of maize: R. A. EMERSON and S. H. EMERSON. (Read by title.)

Crossing-over and allelomorphism in the grouse locusts: R. K. NABOURS.

The evidence in favor of a linear order of the genes: T. H. MORGAN.

Reversal of dominance in a meal-moth producing some new phenotypic ratios: P. W. WHITING.

The globe mutation in Datura: A. F. BLAKESLEE.

Some factors in growth correlations: E. W. SINNOTT.

On some growth-changes in the body-form of Mellita: W. J. CROZIER. (Read by title.)

The effects of inbreeding on guinea-pigs: SEWALL WRIGHT.

Quantitative relations between chromatin and cytoplasm in the genus Arcella, with their relations to external characters: R. W. HEGNER. (Read by title.)

The Naturalists' dinner was held on the evening of December 28 at the Hotel Emerson with sixty-five in attendance. Following the dinner Professor A. O. Lovejoy led a round table discussion by members of the American Association of University Professors of the work of certain of its committees.

The officers of the society for 1919 are:

President—Edward M. East, Harvard University.

Vice-president—John H. Gerould, Dartmouth College.

Secretary—Bradley M. Davis, University of Pennsylvania (1917–19).

[2] In other words, the conditions of hydrostatic equilibrium imply an inclined surface of the liquid with its maximum head in the region of the illuminated part. But such a structure is gravitationally unstable. It is difficult to see, however, why the flow should be an orderly rotation of nearly the whole cylinder of liquid.

NOT TO BE REPRODUCED

Treasurer—J. Arthur Harris, Carnegie Station for Experimental Evolution (1918–20).

Additional members of the Executive Committee—Maynard M. Metcalf, Oberlin, Ohio (1919); Raymond Pearl, Johns Hopkins University (1917–1919); George H. Shull, Princeton University (1918–20); William E. Castle, Harvard University (1919–21).

Bradley M. Davis,
Secretary

THE AMERICAN FOLK-LORE SOCIETY

The American Folk-Lore Society met in annual session on Friday, December 27, at the Johns Hopkins University. The following papers were read and discussed:

Cape Verde Islands variants of the tale of "the witch and the dogs": Elsie Clews Parsons, New York.

Ceremonies of the Eskimo of St. Lawrence Island: Riley D. Moore, Washington.

The retiring president, C. M. Barbeau, was prevented by illness from attending and delivering the presidential address entitled "The field of European folk-lore in America." The following papers in the absence of the authors were read by title:

Resources of Celtic folk-lore in northeast America: Edward J. O'Brein.

Some French-Canadian folk-songs from Gaspé: Loraine Wyman.

The officers of the society for 1919 are the following:

President—Dr. Elsie Clews Parsons.
First Vice-president—E. C. Hills.
Second Vice-president—J. W. Fewkes.
Permanent Secretary—Charles Peabody.
Treasurer—A. M. Tozzer.
Editor—Franz Boas.

THE AMERICAN ANTHROPOLOGICAL ASSOCIATION

The American Anthropological Association held its sessions on December 27 and 28 at Johns Hopkins University, Baltimore. The Friday morning meeting was devoted to the reading of papers and their discussion as in former years. The following papers were read:

The estimated weight of the parts of the lower extremities in living men: Robert Bennett Bean, University of Virginia.

The relation of towers to prehistoric Pueblos: J. Walter Fewkes, Bureau of American Ethnology.

Indian mounds and other relics of Indian life in Texas: J. E. Pearce, The University of Texas.

In memoriam, Herman K. Haeberlin: Franz Boas, Columbia University.

In addition to these the following were read by title in the absence of the authors:

Ceremonial objects excavated at Otowi, New Mexico: Lucy L. W. Wilson, Philadelphia.

Excavations at Hawikuh, New Mexico, in 1917 and 1918: F. W. Hodge, Museum of the American Indian (Heye Foundation).

Mountain haunts of the coastal Algonquins: Max Schrabisch, Paterson, N. J.

Ethnography of the Jugoslavs: Beatrice Stevenson Stanoyevich, New York.

At the Saturday morning session, papers which had already been published were taken up for discussion. This innovation resulted from the experience of past years, that worth-while discussion of papers, new and just read, was seldom possible.

At the business sessions of the council of the association Professor J. C. Merriam, of the Executive Committee of the National Research Council, presented for discussion a plan for a future permanent research body which should include a division of anthropology. The matter was referred to a committee consisting of Professor Boas, Dr. Hrdlička, and Professor Tozzer, who were directed to present definite research problems of the types most likely to be undertaken and to ascertain the organization best adapted for dealing to advantage with such problems.

The following officers were elected:

President—Clark Wissler, Museum of Natural History, New York.

Vice-president, 1919—John R. Swanton, Bureau of American Ethnology.

Vice-president 1920—George Grant MacCurdy, Yale University.

Vice-president, 1921—A. Hrdlička, U. S. National Museum.

Vice-president, 1922—B. Laufer, Field Museum of Natural History.

Secretary—Alfred M. Tozzer, Harvard University.

Treasurer—Neil M. Judd, U. S. National Museum.

Editor—Pliny E. Goddard, American Museum of Natural History.

Associated Editors—John R. Swanton, Robert H. Lowie.

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